

Encyclopedia of Networked and Virtual Organizations

*Goran D. Putnik
University of Minho, Portugal*

*Maria Manuela Cunha
Polytechnic Institute of Cávado and Ave, Portugal*

Volume I
A–F

Information Science
REFERENCE

INFORMATION SCIENCE REFERENCE

Hershey • New York

Acquisitions Editor: Kristin Klinger
Development Editor: Kristin Roth
Senior Managing Editor: Jennifer Neidig
Managing Editor: Sara Reed
Copy Editors: Amanda Appicello, Alana Bubnis, Ashley Fails, April Schmidt, Katie Smalley, and Larissa Vinci
Typesetters: Jeff Ash and Jamie Snively
Cover Design: Lisa Tosheff
Printed at: Yurchak Printing Inc.

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue, Suite 200
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com/reference>

and in the United Kingdom by
Information Science Reference (an imprint of IGI Global)
3 Henrietta Street
Covent Garden
London WC2E 8LU
Tel: 44 20 7240 0856
Fax: 44 20 7379 0609
Web site: <http://www.eurospanonline.com>

Copyright © 2008 by IGI Global. All rights reserved. No part of this publication may be reproduced, stored or distributed in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher.

Product or company names used in this set are for identification purposes only. Inclusion of the names of the products or companies does not indicate a claim of ownership by IGI Global of the trademark or registered trademark.

Library of Congress Cataloging-in-Publication Data

Encyclopedia of network and virtual organization / Goran D. Putnik and Maria Manuela Cunha, editors.
p. cm.

Summary: "This book documents the most relevant contributions to the introduction of networked, dynamic, agile, and virtual organizational models; definitions; taxonomies; opportunities; and reference models and architectures. It creates a repository of the main developments regarding the virtual organization, compiling definitions, characteristics, comparisons, advantages, practices, enabling technologies, and best practices"--Provided by publisher.

ISBN 978-1-59904-885-7 (hardcover) -- ISBN 978-1-59904-886-4 (e-book)

1. Business enterprises--Computer networks. 2. Virtual corporations. 3. Virtual reality in management. 4. Management information systems. 5. Knowledge management. I. Putnik, Goran, 1954- II. Cunha, Maria Manuela, 1964-
HD30.37.E53 2008
658.4'038--dc22

2008004512

British Cataloguing in Publication Data

A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this encyclopedia set is new, previously-unpublished material. The views expressed in this encyclopedia set are those of the authors, but not necessarily of the publisher.

Editorial Advisory Board

Abbe Mowshowitz
The City College of New York, USA

Antonio Lucas Soares
Universidade do Porto, Portugal

Bernard Grabot
l'Ecole Nationale d'Ingénieurs de Tarbes, France

Bernhard Katzy
University of Leiden, Germany

Bill Lawless
Paine College, USA

Bob Travica
University of Manitoba, Canada

Eldaw E. Eldukhri
Cardiff University, UK

Erik den Hartigh
Delft University of Technology, The Netherlands

Eugenio Oliveira
Universidade do Porto, Portugal

Harinder S. Jagdev
University of Manchester, UK

Janet Efstathiou
University of Oxford, UK

Ljubo Vlacic
Griffith University, Australia

Luis M. Camarinha-Matos
Universidade Nova de Lisboa, Portugal

Nada Lavrac
Jozef Stefan Institute, Slovenia

Nicolaos Protogeros
University of Macedonia, Greece

Peter Bernus
Griffith University, Australia

Ricardo Gonçalves
Universidade Nova de Lisboa, Portugal

Shimon Y. Nof
Purdue University, USA

Stanislav Karapetrovic
University of Alberta, Canada

Subhasish Dasgupta
The George Washington University, USA

Thomas Saaty
University of Pittsburgh, USA

Vinesh Raja
University of Warwick, UK

Vladimir Marik
Czech Technical University in Prague, Czech Republic

Weiming Shen
The University of Western Ontario, Canada

Contents

by Volume

Volume I

Agent-Based Approach to Designing VO, An / <i>Narjès Bellamine-Ben Saoud</i>	1
Agent-Based Network Infrastructure for E-Communities / <i>M. Mari, A. Poggi, and M. Tomaiuolo</i>	10
Agent-Facilitated Virtual Marketplace for Airline Ticketing / <i>Sheng-Wei Guan</i>	19
Agile and Virtual University / <i>Maria Manuela Cunha, Goran D. Putnik, and Eva Miranda</i>	26
Agile Holonic Network Organizations / <i>Paul T. Kidd</i>	35
Ambiguity and Group Consensus / <i>Morgan M. Shepherd, Ben Martz, and Vijay Raghavan</i>	43
Analysis, Valuation, and Disclosure of Intangible Value / <i>Natália Canadas</i>	51
Basic Concepts of Wireless Sensor Networks / <i>Lina M. Pestana Leão de Brito and Laura M. Rodríguez Peralta</i>	57
Better Interoperability in Smart Organizations / <i>Ricardo Jardim-Goncalves, Maria Jose Nunez, Amparo Roca-Togores, and A. Steiger-Garcia</i>	65
BM_VE Architecture Reference Model for Concurrent Engineering / <i>Antonio José Caulliraux Pithon and Goran D. Putnik</i>	74
Broker's Direct Cost and Time Variables and Expressions / <i>Paulo Silva Ávila, Goran D. Putnik, Maria Manuela Cunha and Ana Madureira</i>	82
Building Trust in Globally Distributed Teams / <i>Julia Kotlarsky, Ilan Oshri, and Paul C. van Fenema</i>	92
Bumerang / <i>António José Videira Tavares</i>	100
Business Ecosystem / <i>Erik den Hartigh and Michiel Tol</i>	106
Business Process Modification Management / <i>Benjamin Urh, Tomaž Kern and Matjaž Roblek</i>	112

Business-to-Business Networks / <i>Sean Eom</i>	121
Campus as a Framework for a Networked University / <i>Josep Cobarsí Morales</i>	129
Capacity Building in SME Tourism Networks / <i>Patrice Braun and Mary Hollick</i>	136
Case Study in the Role of Trust in Web Service Securities, A / <i>Pauline Ratnasingam</i>	142
Case Study on Inter-Organizational Systems and Power, A / <i>Albert Boonstra</i>	153
Challenges of VO Inheritance / <i>Iris Karvonen and Martin Ollus</i>	161
Characterization and Classification of Collaborative Tools / <i>Javier Soriano, Rafael Fernández, and Miguel Jiménez</i>	167
Characterization and Classification of Cross-Organizational Business Processes / <i>Dirk Werth</i>	175
Characterizing E-Learning Networked Environments / <i>Samuel Pierre</i>	181
Children with Special Needs as a Virtual Community / <i>Tas Adam and Arthur Tatnall</i>	187
Classes of Collaborative Networks / <i>Luis M. Camarinha-Matos and Hamideh Afsarmanesh</i>	193
Clustering Analysis of Networked Organizations / <i>I. Hakki Eraslan, Melih Bulu, and Metin Turkey</i>	199
Collaboration Based on Web Services / <i>Giorgio Bruno and Marcello La Rosa</i>	209
Collaborative Alliance for the Implementation of Computer Integrated Manufacturing in Small and Medium Enterprises / <i>H.B. Marri, A. Gunasekaran, Z. Irani, and Goran D. Putnik</i>	216
Collaborative Development Environments / <i>Javier Soriano, Genovea López, and Rafael Fernández</i>	225
Collaborative Development within Open Source Communities / <i>Javier Soriano, Sonia Frutos, and Miguel Jiménez</i>	232
Collaborative Networks and Virtual Support Enterprises / <i>Jayantha P. Liyanage and Mike Herbert</i>	237
Collaborative Performance Measurement / <i>Thomas Matheis, Björn Simon, and Dirk Werth</i>	244
Collaborative Techniques in Customer's Involvement / <i>Marina Rodriques Brochado and Antonio Jose Caulliraux Pithon</i>	252
Collaborative Work Training in Higher Education / <i>María Dolores Olvera-Lobo, Rosa María Castro-Prieto, Enrique Quero-Gervilla, Ricardo Muñoz-Martín, Eva Muñoz-Raya, Miguel Murillo-Melero, Bryan Robinson, and José Antonio Senso-Ruiz</i>	261
Collaborative Working in an ISP Environment / <i>Sathya Rao, Eric Mannie-Corbisier, and Leszek Siwik</i>	269

Collective Intelligence / <i>Paulo Garrido and Wilfried Lemahieu</i>	280
Comparing ZigBee, Bluetooth, UWB, and Wi-Fi / <i>Gonçalo Nuno Sol Teixeira, Laura Margarita, and Rodriguez Peralta</i>	288
Competency Concept in VO Breeding Environments / <i>Nathalie Galeano, Ekaterina Ermilova, Jorge Giraldo, Hamideh Afsarmanesh, and Arturo Molina</i>	297
Computer Networking of Cybercafés in Delta State, Nigeria / <i>Oghenevwogaga Benson Adogbeji and Esharenana E. Adomi</i>	305
Concept of Collaboration / <i>Luis M. Camarinha-Matos and Hamideh Afsarmanesh</i>	311
Concepts, Issues, and Challenges of Virtual Universities / <i>Yukiko Inoue</i>	316
Constructing Virtual Libraries / <i>Maria da Conceição Carvalho Maltez and Antonio Moreira</i>	323
Context-Awareness in Pervasive Environments / <i>Frederico Moreira Bublitz, Emerson Loureiro, Hyggo Almeida, Evandro Costa, and Angelo Perkusich</i>	331
Conversational Pragmatics and Learning in Virtual Organizations / <i>Rocci Luppichini</i>	337
Cooperative Interaction in Virtual Education / <i>Ángel García del Dujo and Cristóbal Nico Suárez Guerrero</i>	346
Costs, Benefits, and Risks of E-Government Portals / <i>Rostislav Markov and Shota Okujava</i>	354
Critical Success Factors and Core Competencies / <i>Helena Santos Rodrigues and Pedro Figueroa Dorrego</i>	364
Cross-Cultural Learning Objects (XCLOs) / <i>Andrea L. Edmundson</i>	369
Customizing Multimedia and Collaborative Virtual Environments / <i>Paulo N.M. Sampaio, Ildeberto A. Rodello, Laura M. Rodríguez Peralta, and Paulo Alexandre Bressan</i>	377
Cybercells for Virtual Teaching and Learning / <i>Ken Stevens</i>	385
Design and the Virtual Organization / <i>Paula Rodrigues</i>	391
Designing Contracts for Business Networks / <i>Peter Rittgen</i>	395
Developing B2B Virtual Enterprises / <i>Ghazi Alkhatib and Zakaria Maamar</i>	402
Development of a University Networking Project / <i>J. A. R. Pacheco de Carvalho, P. A. J. Gomes, H. Veiga, and A. D. Reis</i>	409
Dialectical Discourse Management through Online Collaboration / <i>Katia Passerini</i>	423
Digital Divide in Education in the Knowledge Society, The / <i>Almudena Moreno Mínguez and Enrique Crespo Ballesteros</i>	430

Discovery and Existence of Communities in the World Wide Web / <i>Antonis Sidiropoulos, Dimitrios Katsaros, and Yannis Manolopoulos</i>	436
Distributed Work Arrangements Supporting Organizational Needs / <i>Kathy O. Roper and Jun Ha Kim</i>	443
e-Cat for Partner Profiling and Competency Management Tool / <i>Jiří Hodík, Jiří Vokřínek, and Petr Bečvář</i>	452
Economic Development Alliances / <i>Fred Young Phillips</i>	459
E-Learning Tool for Regional Development / <i>Maria Teresa de Noronha Vaz, Sílvia Brito Fernandes, and Eric de Noronha Vaz</i>	467
E-Markets as Meta-Enterprise Information Systems / <i>Martin Grieger, Evi Hartmann, and Herbert Kotzab</i>	475
Enterprise Cost/Benefit Risk Analysis Using FMEA / <i>Ian McKeachie and Ljubo Vlacic</i>	484
Environmental Sciences and Distance Education / <i>Cristina Carapeto</i>	492
Environments for VE Integration / <i>Maria Manuela Cunha and Goran D. Putnik</i>	499
E-Portfolio and Pedagogical Change for Virtual Universities / <i>Kam Hou Vat</i>	508
E-Portfolios in Teacher Education / <i>Kevin Marshall</i>	516
European Virtual Enterprise on Collaborative Data Mining and Decision Support, A / <i>Dunja Mladenčić and Nada Lavrač</i>	524
Evaluating Organisational Readiness for Virtual Collaboration / <i>Peter Gall and Janice Burn</i>	530
Evaluating Processes and Performance in Virtual Teams / <i>Ying-Chieh Liu, Janice M. Burn, and Susan Stoney</i>	538
Evaluating Virtual Organisational Preparedness / <i>Peter Gall and Janice Burn</i>	550
Evolution of Virtual Universities / <i>Marion Cottingham</i>	558
Exploratory Analysis of the Role of Emotions in E-Learning, An / <i>M. A. Rentroia-Bonito, J. A. Jorge, and C. Ghaoui</i>	563
Exploring Environmental Factors in Virtual Teams / <i>Teresa Torres-Coronas</i>	572
Extended Enterprise Integration vs. Market B2B Integration / <i>Frank G. Goethals, Wilfried Lemahieu, Monique Snoeck, and Jacques Vandenbulcke</i>	578
Extent of Network Effects and Social Interaction Effects / <i>Erik den Hartigh</i>	587

ExtraPlanT as a Multi-Agent System for Extra-Enterprise Collaboration / <i>Jiří Vokřínek, Jiří Hodík, Michal Pěchouček, Petr Bečvář, and Jiří Pospíšil</i>	593
Fair Distribution of Collaboration Benefits / <i>António Abreu and Luis M. Canarina-Mato</i>	601
Fine-Grained Data Security in Virtual Organizations / <i>Harith Indraratne</i>	608
Formal Modeling and Verification of Virtual Community Systems / <i>Elthon Oliveira, Hygo Almeida, Leandro Silva, Nadia Milena, Frederico Bublitz, and Angelo Perkusich</i>	614
Fuzzy Multi-Agent System for Combinatorial Optimization, A / <i>Carlos Cruz Corona, Juan R. González, Alejandro Sancho Royo, and David Pelta</i>	622

Volume II

Galois Lattice Quantum Model for NVOs / <i>W.F. Lawless, Laurent Chaudron, and C.P. Abubucker</i>	629
Geography of the Information Society / <i>Jorge Ricardo Costa Ferreira</i>	635
Grid Computing for Social Science / <i>Kenneth J. Turner, Paul Lambert, K. L. Tan, Vernon Gayle, Richard O. Sinnott, Ken Prandy, Erik Bihagen, and Marco H. D. van Leeuwen</i>	643
Guidelines for Deploying a Knowledge Management System / <i>J. Ares, A. Rodríguez-Patón, and S. Suárez</i>	652
Historical Perspective of Web Engineering, A / <i>Guangzhi Zheng</i>	660
Human Factors for Networked and Virtual Organizations / <i>Vincent E. Lasnik</i>	668
Human-Integrated Assist Systems for Intelligence Operators / <i>Hirohisa Sakai and Kakuro Amasaka</i>	678
Improving Customer Relations through E-Commerce / <i>Alexander O. Rodriguez, Dorothy G. Dologite, Robert J. Mockler, and Marc E. Gartenfeld</i>	688
Improving User Satisfaction in VO through Systems Usability / <i>Dulce Magalhães de Sá</i>	694
Industrial Web Portal for Remonte Supervisory Control / <i>Lenka Landryová and Iveta Zolotová</i>	700
Industry and Academia Networks / <i>Fernando Romero</i>	708
Information Disasters in Networked Organizations / <i>Josep Cobarsí Morales</i>	717
Innovative Production Machines and Systems Network of Excellence / <i>D. T. Pham, E. E. Eldukhri, A. Soroka, V. Zlatanov, M. S. Packianather, R. Setchi, P. T. N. Pham, A. Thomas, and Y. Dadam</i>	725
Integration and Information Sharing in E-Government / <i>Asli Yagmur Akbulut and Jaideep Motwani</i>	729

Interaction in Corporative Learning / <i>Helder Fanha Martins and Maria João Ferro</i>	735
ISSAAC Model of Virtual Organization, The / <i>Bob Travica</i>	745
Key Concepts and Definitions of Open Source Communities / <i>Ruben van Wendel de Joode and Sebastian Spaeth</i>	753
Key Concepts and Protocols in E-Voting / <i>Rui F. L. Joaquim</i>	761
Knowledge Blogs in Firm Internal Use / <i>Miia Kosonen, Kaisa Henttonen, and Kirsimarja Blomqvist</i>	769
Knowledge Communities and Inter Organizational Networks / <i>Dora Simões and António Lucas Soares</i>	777
Knowledge Transfer in G2G Endeavors / <i>Luiz Antonio Joia</i>	783
Knowledge Transfer and Sharing in Globally Distributed Teams / <i>Ilan Oshri, Julia Kotlarsky, and Paul C. van Fenema</i>	789
Knowledge-Based E-Learning in Virtual Enterprises / <i>Ana C. Andrés del Valle</i>	795
Learning Object Evaluation / <i>Erla M. Morales, Francisco J. García, and Ángela Barrón</i>	800
Learning Reflection and Creativity in Online Game Communities / <i>Tunç D. Medeni, Mark Elwell, Steven A. Cook, and Euler G. M. de Souza</i>	808
Living Labs Approach to a Virtual Lab Environment, The / <i>Miguel Ponce de Leon, Karl A. Hribernik, and Mats Eriksson</i>	818
Local Networks in Global Markets / <i>Iva Miranda Pires</i>	822
Localization, Culture and Global Communication / <i>Gerhard Chroust</i>	829
Logistic Models for Symbiosis, Predator-Prey and Competition / <i>Ricardo Lopez-Ruiz and Danièle Fournier-Prunaret</i>	838
Long-Term Contracts in the Cellular Phone Industry / <i>Donald Barnes and John Kirk Ring</i>	848
Management of a Virtual Construction Management Services Company / <i>Wafa Alsakini, Juhani Kiiras, and Pekka Huovinen</i>	856
Management of Distributed Project Teams in Networks / <i>Paul C. van Fenema, Ilan Oshri, and Julia Kotlarsky</i>	867
Managerial Perspective of Mobile VoIP, A / <i>Mahesh S. Raisinghani</i>	874
Managing the Dynamic Reconfiguration of Enterprises / <i>Ben Clegg and Mario Binder</i>	882
Market of Resources: A Cost and Effort Model / <i>Maria Manuela Cunha and Goran D. Putnik</i>	891

Market of Resources: Opportunities Domain / <i>Maria Manuela Cunha and Goran D. Putnik</i>	899
Market of Resources: Supporting Technologies / <i>Maria Manuela Cunha, Goran D. Putnik and Joaquim P. Silva</i>	906
Market of Resources for Healthcare Teleservices Management / <i>Maria Manuela Cunha, Goran D. Putnik, and Ricardo Simões</i>	913
Market of Resources for Virtual Enterprise Integration / <i>Maria Manuela Cunha, Goran D. Putnik, and Paulo Silva Ávila</i>	918
Measures of Network Structure / <i>Ani Calinescu and Janet Efstathiou</i>	926
Meta-Analysis Research on Virtual Team Performance / <i>Ying-Chieh Liu, Janice M. Burn, and Susan Stoney</i>	933
Mobile Virtual Communities / <i>Glauber Ferreira, Hyggo Almeida, Angelo Perkusich, and Evandro Costa</i>	944
Mobile Virtual Communities of Commuters / <i>Jalal Kawash, Christo El Morr, Hamza Taha, and Wissam Charaf</i>	950
Morphology and Entropy in Networks / <i>Ton van Asseldonk, Erik den Hartigh, and Leon Berger</i>	957
Multi-Criteria Partner Selection in Virtual Organizations / <i>Toni Jarimo, Peter Ljubič, Jiří Hodík, Iiro Salkari, Marko Bohanec, and Nada Lavrač</i>	964
Mutual Value in Business Relationships / <i>Rita de Cássia de Faria Pereira, Carlo Gabriel Porto Bellini, and Fernando Bins Luce</i>	971
Nature-Inspired Cooperative Strategies for Optimization / <i>Juan R. González, Alejandro Sancho-Royo, David A. Pelta, and Carlos Cruz</i>	982
Navigation at the Internet Front Line / <i>Nurun Nahar, Tunç D. Medeni, and Saber Zrelli</i>	990
Negotiation Support Systems and Teams in VO / <i>Xiaojia Guo and John Lim</i>	1001
Network Effects / <i>Erik den Hartigh</i>	1007
Network Effects and Market Outcomes / <i>Erik den Hartigh</i>	1014
Network of Excellence as Virtual Communities / <i>Anca Draghici, Nada Matta, Gila Molcho, and George Draghici</i>	1022
Network of Intelligent Agents / <i>Germano Resconi</i>	1031
Networked Memex Based on Personal Digital Library / <i>Sheng-Wei Guan and Xiaobiao Zhang</i>	1044
Networking and Corruption / <i>Aleš Pachmann and Jaroslav Dvorak</i>	1052

Networks and Industrial Clusters / <i>Filipa Vieira and Fernando Romero</i>	1058
New Computer Network Paradigms and Virtual Organizations / <i>Guillermo Agustín Ibáñez Fernández</i>	1066
New Perspective for Network Innovation, A / <i>Cristina S. Rodrigues, Edite M.G.P. Fernandes, and F. Vitorino Martins</i>	1074
New Process of Work, The / <i>Maria do Rosário Alves de Almeida</i>	1080
New Way of Conjoint Added Value Generation in Collaborative Business Processes, A / <i>Dirk Werth</i>	1087
NGO Forum, The / <i>Nurun Nahar, Tunç D. Medeni, and Tolga Medeni</i>	1093
Older People, the Internet, and Virtual Communities / <i>Jerzy Lepa and Arthur Tatnall</i>	1102
Online Communication and Social Engagement / <i>Jason D. Baker and Robert H. Woods</i>	1108
Online Corporate Collaborative Teams / <i>Helder Fanha Martins and Maria João Ferro</i>	1112
Online Tutoring and Mentoring / <i>Antonio Miguel Seoane Pardo and Francisco José García</i>	1120
Ontologies for Collaborative Networked Organizations / <i>Joël Plisson, Peter Ljubič, Igor Mozetič, and Nada Lavrač</i>	1128
Ontology and Expertise Map Building in Virtual Organizations / <i>Gila Molcho, Anca Draghici, and Nada Matta</i>	1136
Open University of Catalonia as a Virtual University, The / <i>Josep Cobarsí Morales</i>	1145
Optimizing Paths with Random Parameter Distributions / <i>D. M. L. D. Rasteiro</i>	1151
Outsourcing and Strategic Outsourcing / <i>Sonia Dahab and Filipe Amaral</i>	1164
Pair Modeling / <i>Pankaj Kamthan</i>	1171
Participatory Geographic Information Systems / <i>Dulce Magalhães de Sá and Ana Cristina M. Costa</i>	1179
Peer-to-Peer Methods for Operating System Security / <i>Zoltán Czirkos and Gábor Hosszú</i>	1185
Perception of VO Reliability / <i>Jerzy Kisielnicki and Tomasz Ochowski</i>	1192
Performance Analysis and Models of Web Traffic / <i>Federico Montesino Pouzols, Angel Barriga Barros, Diego R. Lopez, and Santiago Sánchez-Solano</i>	1196
Performance Analysis of Multimedia Traffic / <i>Federico Montesino Pouzols, Diego R. Lopez, Angel Barriga Barros, and Santiago Sánchez-Solano</i>	1204
Performance Analysis of Peer-to-Peer Traffic / <i>Federico Montesino Pouzols, Angel Barriga Barros, Diego R. Lopez, and Santiago Sánchez-Solano</i>	1210

Performance Measurement of Computer Networks / <i>Federico Montesino Pouzols, Angel Barriga Barros, Diego R. Lopez, and Santiago Sánchez-Solano</i>	1216
Pervasive and Grid Computing Merging / <i>Loreno Oliveira, Emerson Loureiro, Hyggo Almeida, and Angelo Perkusich</i>	1223
PMA Supplier Selection Using the Mahalanobis Taguchi System / <i>T.T. Wong</i>	1230
Post-Modern Tribes as a Marketing Tool / <i>Laura A. Ripamonti and Armando Cirrincione</i>	1238
Pricing Quality of Service in Diffserv IP Networks / <i>Vladanka S. Acimovic-Raspopovic and Mirjana D. Stojanovic</i>	1245
Problem with People and Information Security, The / <i>Alexandre Cerveira, Leonilde Reis, and José Gaivéo</i>	1252
Process Management Methodology / <i>Paula Ventura Martins and Alberto Rodrigues da Silva</i>	1259
Process of Innovation in Beira Interior / <i>Maria Manuela Santos Natário and Paulo Alexandre Neto</i>	1266
Project Management in Innovation Networks / <i>Adam Melski, Jan Borchert, and Svenja Hagenhoff</i>	1276
ProPlanT as a Multi-Agent Technology for Decision Making Support / <i>Vladimír Mařík, Michal Pěchouček, and Jiří Vokřínek</i>	1287

Volume III

Public Grid Computing Projects Survey and Analysis / <i>Nolan J. Taylor</i>	1295
Public Private Networks / <i>Oliver Bohl, Ruth Schaefer, and Udo Winand</i>	1300
Purchasing as an Integrated Competence / <i>Cristina S. Rodrigues, Edite M.G.P. Fernandes, and F. Vitorino Martins</i>	1309
QoS Provisioning Framework in IP-Based VPN / <i>Mirjana D. Stojanovic and Vladanka S. Acimovic-Raspopovic</i>	1317
Quality Learning Objective in Instructional Design / <i>Erla M. Morales, Francisco J. García, and Ángela Barrón</i>	1325
Quality of Service Issue in Virtual Enviroments, The / <i>Pedro Morillo, Juan Manuel Orduña, and Marcos Fernandez</i>	1333
Quantum Real-Time Metric for NVOs, A / <i>W.F. Lawless, C.R. Howard, and Nicole N. Kriegel</i>	1341
Reconfiguration of Communities in Cyberspace / <i>SungBok Park and Ha Sung Hwang</i>	1349

Reflective Ba and Refractive Ma in Cross-Cultural Learning / <i>Tunç D. Medeni, Shunji Iwatsuki, and Steven A. Cook</i>	1357
Relatronics as a Key Concept For Networked Organizations / <i>Tomas Backström and Marianne Döös</i>	1367
Reviewing the Actor-Network Theory / <i>José Figueiredo</i>	1375
Revision of the Bullwhip Effect / <i>David de la Fuente</i>	1381
Risk Management in Enterprise Networking / <i>Iris Karvonen</i>	1388
RSS in Virtual Organizations / <i>Tom Chan</i>	1393
Scales and Dynamics in Outsourcing / <i>Iva Miranda Pires and Torunn Kvinge</i>	1399
Secure Collaborative Learning Practices and Mobile Technology / <i>Hannakaisa Isomäki, Kirsi Pyykkönen, and Hanna Räisänen</i>	1407
Self-Modelling Knowledge Networks / <i>Volker Derballa and Atonia Albani</i>	1413
Semantic E-Business Challenges and Directions / <i>Giorgos Laskaridis, Konstantinos Markellos, Penelope Markellou, Angeliki Panayiotaki, and Athanasios Tsakalidis</i>	1421
Service-Oriented Architectures and ESB in VE Integration / <i>Nicolaos Protogeros</i>	1429
Service-Oriented Architecture for Business Process Management / <i>Katrina Leyking and Jörg Ziemann</i>	1437
Sharing Knowledge in Virtual Communities / <i>Iris Reyshav and Jacob Weisberg</i>	1446
Social Interaction Effects / <i>Erik den Hartigh</i>	1454
Social Knowledge in Multi-Agent Systems / <i>Vladimír Mařík and Michal Pěchouček</i>	1459
Social Network Analysis for Investigating Large Scientific Research Project / <i>Kun Nie, Euler G. M. de Souza, and Tunç D. Medeni</i>	1466
Social Network Analysis for Virtual Communities / <i>Francisco Ignacio Revuelta Dominguez</i>	1473
Social Networks through an Entrepreneurial Mindset / <i>Euler G. M. de Souza, Tunç D. Medeni, and Kun Nie</i>	1477
Socio-Semantic Web for Sharing Knowledge / <i>Cristian Peraboni and Laura A. Ripamonti</i>	1482
Software Agents and Contracts / <i>Francisco Andrade, Paulo Novais, and José Neves</i>	1489
Software Quality in Open Source Software Ecosystems / <i>Pankaj Kamthan</i>	1496
Spatial Autocorrelation and Association Measures / <i>J. Negreiros, M. Painho, I. Lopes, and A.C. Costa</i>	1502

Strategic Decision Making in Global Supply Networks / <i>Ozlem Arisoy and Bopaya Bidanda</i>	1509
Strategic QCD Studies with Affiliated and Non-Affiliated Suppliers Utilizing New JIT / <i>Kakuro Amasaka</i>	1516
Strategies for Virtual Organizations / <i>Juha Kettunen</i>	1528
Strategies for Virtual Work / <i>Paul Jackson and Jane E. Klobas</i>	1535
Structure Analysis of Keiretsu of Toyota, A / <i>Takao Ito, Katia Passerini and Makoto Sakamoto</i>	1542
Student Teacher Collaborative Community, A / <i>Eugenia M. W. Ng</i>	1549
Sense of Virtual Community / <i>Hanna-Kaisa Ellonen, Miia Kosonen, and Kaisa Henttonen</i>	1559
Supply Chain Integration in the Construction Industry / <i>José Telhada, Tiago Pinho, and Maria Sameiro Carvalho</i>	1567
Survey of Link Analysis Ranking, A / <i>Antonis Sidiropoulos, Dimitrios Katsaros, and Yannis Manolopoulos</i>	1573
Surveying Trust in Virtual Organizations / <i>István Mezgár</i>	1579
Synchronous and Asynchronous Communication Systems / <i>António D. Reis, José F. Rocha, Atilio S. Gameiro, and José P. Carvalho</i>	1587
Synchronous Collaboration and Instruction / <i>Helder Fanha Martins</i>	1597
Taxonomy of Broker's Functions in Virtual Enterprises / <i>Paulo Silva Ávila, Goran D. Putnik, Maria Manuela Cunha, and António Pires</i>	1605
Technology Change and Online Community Development / <i>Mark Elwell and Tunç D. Medeni</i>	1614
Technology in Distance Learning / <i>Fernando da Cruz Bandeira</i>	1622
Telework and Data Privacy and Security / <i>Reima Suomi</i>	1631
Thematic Based Group Communication / <i>Raymond Pardede, Gábor Hosszú, and Ferenc Kovács</i>	1636
Tools for Collaborative Business Process Modeling / <i>Paz Pérez González and Jose M Framinan</i>	1643
Tourism Networks and Clusters / <i>Patrice Braun</i>	1653
Training Techniques for Developing Trust in Virtual Teams / <i>Peggy M. Beranek, Ben Martz, and Monique French</i>	1659
Training to Improve Trust in Virtual Teams / <i>Monique French and Peggy M. Beranek</i>	1667

Trends and Future Directions of Net-Enabled Connectivity / <i>Indushobha Chengalur-Smith and Peter Duchessi</i>	1675
Trust and its Impersonal Nature / <i>Miia Kosonen, Kirsimarja Blomqvist, and Riikka Ellonen</i>	1683
Trust in Networks and Clusters / <i>Patrice Braun</i>	1691
Trust in Virtual Communities / <i>Luis V. Casaló, Carlos Flavián, and Miguel Guinaliu</i>	1697
Understanding and Using Boundaries in NVOs / <i>Haigang Song, Tunç D. Medeni, Euler G. M. de Souza, and Kun Nie</i>	1705
Understanding the Virtual Community of Gamers / <i>Shafiz Affendi Mohd Yusof</i>	1714
Using Annotations for Information Sharing in a Networked Community / <i>Muhammad Asim Qayyum</i>	1722
Using Telework and E-Work as Flexible Working Alternatives / <i>Flávio Nunes</i>	1730
Using View Process Models in Collaborative Business Processes / <i>Jörg Ziemann, Timo Kahl, and Dirk Werth</i>	1735
Value Creation Process in Networked Organizations, The / <i>Jorge Luís Pedreira Murteira Marques Casas Novas</i>	1743
Via Nova Academy / <i>J.P.T. Thijssen</i>	1750
Virtual Community and Online Game Players / <i>Jengchung V. Chen and Yu-Hsiang Wang</i>	1757
Virtual Community for Mobile Agents, A / <i>Sheng-Uei Guan and Fangming Zhu</i>	1764
Virtual Community of Learning Object Repository / <i>Lee Gilliean</i>	1772
Virtual Enterprise Environments for Scientific Experiments / <i>Andrea Bosin, Nicoletta Dessì, Maria Grazia Fugini, Diego Liberati, and Barbara Pes</i>	1779
Virtual Informatics Museum / <i>José Maria Fernandes de Almeida</i>	1785
Virtual Knowledge-Building Communities / <i>Sheizaf Rafaeli, Tsahi Hayat, and Yaron Ariel</i>	1792
Virtual Laboratory of Mathematics Education, A / <i>Pedro Palhares and Alexandra Gomes</i>	1797
Virtual Logistics from Outsourcing Logistics / <i>Vladimír Modrák</i>	1805
Virtual Modeling and Prototyping in Collaborative Product Design / <i>Ricardo Simões</i>	1812
Virtual Organizations in Commercial Games / <i>Michael Barlow</i>	1819
Virtual Organizations Management / <i>Kim Jansson, Iris Karvonen, Martin Ollus, Iiro Salkari, Ugo Negretto, Alexandra Klen, and Paolo Paganelli</i>	1827

Virtual Repository Development in Canada / <i>Rocci Luppicini</i>	1834
Virtuality Among Construction Management Services Companies / <i>Wafa Alsakini, Juhani Kiiras, and Pekka Huovinen</i>	1843
VO as an Alternative to Hierarchy in the Dutch Police Sector / <i>Peter Groenewegen and Pieter Wagenaar</i>	1851
VO Breeding Environments Value System and Metrics / <i>David Romero, Nathalie Galeano, and Arturo Molina</i>	1858
Web-Based Business Reporting in Virtual Enterprises / <i>Raif Parlakkaya, Adem Öğüt, and M. Tahir Demirsel</i>	1864
Web-Based English Writing Courses for Graduate Students / <i>Hsien-Chin Liou, Chih-Hua Kuo, Jason S. Chang, Hao-Jan Chen, and Ching-Fen Chang</i>	1871
XBRL in Business Reporting / <i>Margarida Silva Martins and Lúcia Lima Rodrigues</i>	1879

About the Editors

Goran D. Putnik received his Dipl.Eng., MSci. and DrSci. from the Belgrade University, both MSci. and DrSci. in the area of Intelligent Manufacturing Systems. His current position is aggregated professor, Department of Production and Systems Engineering, University of Minho, Portugal. He teaches the subjects of CAD/CAPP, CAM, FMS and Virtual Enterprises in undergraduate studies, and CAD/CAPP/CAM Systems, Concurrent Engineering, Enterprise Organization, IMS and Design Theory in postgraduate studies. He served as director of the Centre for Production Systems Engineering (CESP) for 4 years and its deputy director for 5 years. He is director of the master and postgraduate course on CIM, and is responsible of the Laboratory for Virtual Enterprises (LABVE), the Department of Production and Systems Engineering, University of Minho. His scientific and engineering interests are production systems and enterprises design and management theory and implementations: CIM, CAD/CAPP/CAM systems, intelligent production systems and enterprises, machine learning as a design theory model, concurrent and collaborative engineering, information systems management, formal theory of production systems and enterprises, distributed, agile and virtual enterprises, and complexity management in organizations. He is supervising a number of PhD projects as well. He regularly publishes and participates on international scientific conferences. He serves as a member on several editorial boards for international journals and has served in more than fifty scientific committees of international conferences. He was also invited lecturer on a number of universities.

* * *

Maria Manuela Cunha is currently associate professor in the Higher School of Technology, Polytechnic Institute of Cávado and Ave, Portugal. She holds a Dipl.Eng. in the field of Systems and Informatics Engineering, an MSci. in the field of Information Society and a DrSci in the field of Virtual Enterprises, all from the University of Minho. She coordinates the scientific domain of Organizations and Information Systems in the Department of Information Systems and Technologies, and teaches subjects related with information systems, software engineering and organizational models, to undergraduated and postgraduated studies. She supervises several PhD projects in the domain of virtual enterprises. Her scientific and engineering interests are electronic business, agile and virtual enterprises and information systems. She regularly publishes and participates on international scientific conferences. She serves as a member on several editorial boards for several international journals and has served in several scientific committees of international conferences.

Collaborative Development Environments



Javier Soriano

Universidad Politécnica de Madrid (UPM), Spain

Genoveva López

Universidad Politécnica de Madrid (UPM), Spain

Rafael Fernández

Universidad Politécnica de Madrid (UPM), Spain

INTRODUCTION

More and more often organizations tend to behave like dynamically reconfigurable networked structures that carry out their tasks by means of collaboration and teamwork. Effective teamwork is an essential part of any non-trivial engineering process, and collaborative capabilities are an essential support for these teams. Software development is no exception; it is in itself a collaborative team effort, which has its own peculiarities. Both in the context of open source software development projects and in organizations that develop corporate products, more and more developers need to communicate and liaise with colleagues in geographically distant areas about the software product that they are conceiving, designing, building, testing, debugging, deploying, and maintaining. In their work, these development teams face significant collaborative challenges motivated by barriers erected by geographic distances, time factors, number of participants, business units or differences in organizational hierarchy or culture that inhibit and constrain the natural flow of communication and collaboration. To successfully overcome these barriers, these teams need tools by means of which to communicate with each other and coordinate their work. These tools should also take into account the functional, organizational, temporal and spatial characteristics of this collaboration. Software product users are now becoming increasingly involved in this process, for which reason they should also be considered.

In the context of the software development process, then, a collaborative development environment (CDE) can be defined as a safe and centralized solution conceived to optimize collaborative and distributed software development generally based on Internet standards.

This chapter introduces and defines the concept of CDE, while stressing the role these environments play in setting up a virtual space for negotiation, brainstorming, discussion, information and knowledge sharing, cooperation, coordination, development and management in engineering projects generally and especially software development projects. It then analyzes the collaboration-related points of conflict in the software development process. This conflict is motivated by issues, such as the space-time distribution of resources, which have a negative impact on both individual and team effectiveness and efficiency. On the basis of this analysis, we describe what essential purposes a CDE should serve, including: (a) the holistic integration of disparate collaborative processes and tools through a collaborative environment that represents a Web-accessible virtual project space, (b) the expansion of visibility and change control, (c) the centralization and administration of resources, and (d) the reinforcement of collaboration, creativity and innovation. We also examine what features and services a CDE should provide.

Then, we introduce the chief classification frameworks, according to which collaborative tools can be ranked by the needs that they satisfy, each one from a different viewpoint. Knowing and considering these frameworks, a team can contextualize the range of collaborative tools available, and compare them from different viewpoints and on the basis of assembled criteria sets to be able to make a grounded decision on what collaborative tools best meet its needs.

Finally, the chapter will refer to how CDEs are related within open source software communities. These communities have led to a change in how software development is viewed, and both communities and CDEs have been clearly influenced each other. A number of software and open source software develop-

ment support web sites that use CDEs to achieve their goals will be presented.

WHAT IS A CDE AND WHERE DO THEY COME FROM?

The issue of CDEs was perhaps taken up for the first time back in 1984, when Iren Greif and Paul Cashman organized a workshop that brought together an influential group of people to examine how to apply technology within a collaborative work environment. This meeting was the source of the “computer-supported cooperative work (CSCW)” concept (Grudin, 1994), which aimed to find an answer to how computer systems can support and coordinate collaborative activities.

A few years later, after further researching the concept of CSCW, Malone and Crowston (1994) introduced *coordination theory*, conceived on the basis of research in several different disciplines like computer science, organization theory, management science, economics, linguistics, and psychology, and according to which they defined coordination as a way of managing dependencies between activities. By characterizing the different types of possible dependencies between task activities, Malone and Crowston were able to identify and, consequently, manage the so-called coordination processes. This investigation identified some of the problems that future CDEs would have to deal with, such as, for example, resources allocation, as well as possible solutions.

Years later, when the technology was far enough evolved and after the Internet had materialized, these coordination processes and all the years of CSCW research led to collaborative tools capable of improving not only the development of software applications, but also the networked exchange of information and ideas from different branches of knowledge, with users who had possibly never worked together before and did not even know each other, based at geographically distant places, even overcoming time differences. This then led to the concept of *groupware* (Baecker, 1993), that is computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment, thanks to the enabling technologies of computer networking, software and services, materializing the ideas emerged from CSCW research (Engelbart, 1992).

Predictably, this activity yielded the first tangible definitions of CDEs. For example, “a CDE is a virtual space wherein all the stakeholders of a project, even if distributed by time or distance, may negotiate, brainstorm, discuss, share knowledge, and generally labor together to carry out some task, most often to create an executable deliverable and its supporting artifacts” (Booch & Brown, 2003). In this definition, the authors establish the key aspects to be taken into account in any CDE. In view of the importance that these environments have gained both in the open source context and the corporate environment with the upsurge of virtual and networked enterprises though, we believe that the definition falls short, as it only states what a CDE is and not how it works. It fails to come up with solutions for the challenges to be met by any CDE concerning the space-time distribution of resources. Therefore, we can add to the definition by saying that a CDE holistically integrates multiple collaborative tools and resources, thanks to which it offers a set of services to aid all the stakeholders in the software development area, including managers, developers, users, commercial software manufacturers and software product support enterprises, to communicate, cooperate and liaise. CDEs consider software development’s social nature and assure that the people who design, produce, maintain, commercialize and use software are aware of and communicate about the activities of the others simply, efficiently and effectively, also encouraging creativity and driving innovation.

CHARACTERIZATION OF A CDE

Grady Booch and Alan W. Brown (2003) state that the purpose of a CDE is to create a foundation that minimizes the frictions that have an impact on the routine work of software developers, reducing both individual and group efficiency. The key points of friction are:

- **The cost of working space start-up and on-going organization.** At the start of a project or when a new member joins, there will be a period of adaptation until the team finds the best tools to use, who to ask, the project status, and so forth.
- **Inefficient work product collaboration.** More than one person sometimes needs to work on the same document at the same time. When this is a critical document, a change control log needs to

be kept, specifying who changed what and why in order to rule out problems with simultaneous modifications, and so forth.

- **Maintaining effective group communication.** Negotiation and ambiguity management are critical tasks not related to programming. Team efficiency suffers to the extent that knowledge is inaccessible or communication mechanisms are defective.
- **Time starvation across multiple tasks.** There never seems to be enough time to do tasks.
- **Stakeholder negotiation.** This is the time it takes to reach consensus among individuals with different viewpoints so that the team can move on.
- **Stuff that doesn't work.** Although often ignored, any item that does not work (network crashes, software package errors, etc.) leads to an interruption and therefore a loss of efficiency

ACDE will help to redirect many of these friction points. Having a visual Web-based environment can help to minimize start-up costs. If this environment also offers a storage system integrating change management and the possibility of saving meta-information, teamwork-derived friction will drop substantially. Communication can be improved using discussion and meeting mechanisms. Time shortages can be counteracted by adding items that act as non-human team members executing scripts or tedious tasks. Negotiation can be improved by automating workflow. If the tool is in widespread use and is also open source, someone else is more likely to have detected and corrected the fault.

In any case, a CDE's worth lies in providing a work environment that minimizes these frictions, allowing the team to focus on its main mission: the production of useful and operational software.

Based on the definition of CDE given here, and also on the friction points previously mentioned, the key purposes a CDE should generally serve are:

- **The holistic integration of disparate collaborative processes and tools through a collaborative environment that represents a Web-accessible virtual project space.** The goal is to broaden the options for communication, cooperation and coordination, fill in missing information, and provide visibility for all resources needed by the team. Additionally, a simple way of capturing data and creating event logs should be provided for the purpose of improving project auditing and

follow-up. All these tasks can be carried out by a single system, composed of subsystems providing different services.

- **The expansion of visibility and change control.** Changes will inevitably occur during project development, and the system has to be able to deal with such changes in a reliable and transparent fashion. A key point for distributed cooperation is a clear and exhaustive change control process. A centralized repository with easy access through a user-friendly interface is also essential.
- **The centralization and administration of resources.** The system should integrate and provide the tools needed for collaboration and for project management, providing methods for implementing the relations between teams, and for document, resources and activity sharing. This reduces isolation, maximizes accuracy and speeds up decision making. The system should also offer maximum usability through a generally Internet-accessible user-friendly interface.
- **The reinforcement of collaboration, creativity and innovation.** Process transparency and information availability have a very positive impact by encouraging a constructive attitude towards and motivating collaboration between teams. The ease with which information can be accessed and new ideas can be effectively shared is a source of inspiration for the creative process.

To further specify, if possible, the definition of a CDE, the following are in our opinion services that a CDE should provide.

Table 1. Services a CDE should provide

- | |
|---|
| <ul style="list-style-type: none"> • Web hosting • Web interface-based administration • File persistence with version control • Visibility control system • Databases and directory services • Fault reporting and monitoring system • Bulletin boards or newsgroups • Mailing lists • Task organizers • New feature request system |
|---|

CLASSIFICATION FRAMEWORKS FOR CDEs

As we have seen, there are a number of collaborative tools that can be used by a team to collaboratively achieve its goals. However, a number of classification frameworks, each one based on a different set of characterizing parameters and criteria, have been proposed to rank tools by the needs they satisfy and allow a team to make a grounded decision on what collaborative tools best meet its needs. Knowing and considering the available frameworks, a team can contextualize the range of collaborative tools available and compare them from different viewpoints.

Making no claims to being exhaustive, some of the most representative frameworks that have been developed to date are concisely reviewed below.

- Conradi and Westfechtel (1998) provide a thorough taxonomy for comparing collaborative tools in a particular area.
- Grudin (1994) classifies collaborative tools based on their functionality, considering their adequacy for (a) the time mode in which communication takes place (real time, asynchronous), (b) team location (distributed, collocated) and (c) predictability or otherwise of this temporality and/or location.
- Nutt (1996), within the framework of workflow systems, defines a 3D domain space based on the underlying workflow model and more specifically on the mode in which the workflow model represents a work procedure. The resulting framework can classify models that represent just structured or explicit work, models conceived to deal with unstructured work, descriptive and analytical workflow models and conventional workflow models among others.
- Malone and Crowston (1994) identify the processes of coordination used by different disciplines to manage dependencies among activities and analyze their interdisciplinary nature. After identifying the processes, they create a taxonomy of process-based collaborative tools to provide support during software development.
- Van der Hoek et al. (2004) classify collaborative tools on the basis of their high-level approach to collaboration, and particularly depending on whether they take a formal process-based ap-

proach, an informal awareness-based approach or they combine both approaches.

- Booch and Brown (2003) classify tools on the basis of the capabilities offered, for which purpose they decompose the characteristics of a CDE into three categories of capabilities based on coordination, collaboration, and the community building nature of a CDE.
- Sarma (2005) classifies the tools depending on their impact on the effort required by users to collaborate effectively instead of focusing on functionality-related aspects and evaluates how sophisticated and automated the support they provide is. The framework classifies the expected user effort that is required to use a particular type of tool and collaborate effectively.

CDEs AND OPEN SOURCE COMMUNITIES

The software development industry has clearly undergone a change of paradigm due to the eruption of the open source phenomenon (Ghosh, 2002). The features distinguishing open source from proprietary software go beyond the merely technical points and stretch to philosophical viewpoints, new economic rules and different market models (Wynants, & Cornelis, 2005). It also brings with it new development models, whose potential for success is well tried and tested, and which differ from the classical methodologies on several points. The chief feature of this new approach is that development is network focused, enabling people who are geographically far apart to collaborate using the Internet to communicate with each other and coordinate their activities. This networked development approach necessarily targets tools that are used during the process and means that the collaborative tools and environments to support open software development are strongly oriented to Internet use.

Organizations that decide to maintain a site to support collaborative project development and place it at the disposal of the open source software community do not do so for their own benefit or at least this is not their sole objective. The ultimate goal is to promote both development and the use of open source software, and one way to do this is to provide tools and resources to enable communication, cooperation and coordination between developers and users.

Almost all these sites host software projects, although there are others that accommodate no software at all and exclusively target information (Shah, 2005). Others accommodate software that shares some special feature or concerns some specific subject matter, whereas others offer their services for projects from many sources for different purposes. Some are very large and have thousands of visitors every day, whereas others are no more than an initiative run by a handful of enthusiasts. There are sites backed by enterprises and companies that have something to say in the open source world and others that are maintained by user associations or communities that come together around a common interest. Finally, some do not release their resources to the open source community, but use them for their own proprietary developments.

The first distinction then is between organizations that offer services to anyone who wants to use them to create an open source software project (provided they are kept under an open licence) and institutions that impose some additional conditions, generally concerning the project subject matter or even the license type. The first group includes, for example, SourceForge.net and Software-Libre.org, which host all sorts of projects provided they are governed by an open license. Most of the projects at Software-Libre.org have a GPL (general public license). SourceForge.net is larger and there is a wider variety of licenses, but most projects have an *open source initiative* approved and certified license, which means that they can be formally termed open source software. These two gateways also host projects on many different subjects, and there are practically no constraints apart from interest or utility.

Other organizations and associations maintain a web site to promote a particular product, stream or subject within the open source community. Alioth's aim is to host projects that are related to the Debian project. It promotes and facilitates the production of software that can ultimately be included in the Linux Debian distribution or serves the project's aims in some way, without placing any constraints on the subject matter of the hosted projects, because Debian is a general-purpose initiative. This improves the product (Debian) thanks to the cooperation of programmers that would probably not have been able to or would not have felt motivated to contribute without these free and accessible resources. The same applies to the Helix Community, the Blender Foundation and the PostNuke Development and Distribution Center. These are all gateways maintained by

the creators of a specific project to produce a product. This product benefits from the related projects and the programmers of these related projects benefit because they have resources and tools at their disposal. This is a clear example of symbiosis. Real is the company behind the Helix Community. The Blender gateway is maintained by volunteers.

While the ultimate goal is to promote the development and use of open source software, some organizations pursue other specific goals not directly related to software development. Generally, these organizations aim to act as mediators between open source software-related information management and open source software organizations and interest groups, such as developers, users, commercial software manufacturers and open source software product support companies. This is a third type of community that covers gateways whose goals include providing a meeting and distribution point for documentation related to open source software products and are also a source of news on what is happening within the community. Another possible related goal is to offer developers and companies the possibility of making themselves known to the public, promoting themselves, and contacting sponsors and potential partners. Berlios is an example of this approach.

Another block includes sites, like Shavannah, whose motivations are a bit different. By providing a project host site, they aim to support, promote or improve a more general ideological project rather than a particular open source tool or product. Shavannah is the site hosting the GNU projects. GNU started up in 1984 with the goal of developing a UNIX-type operating system entirely based on open source software. The *Free Software Foundation (FSF)* is the key organization behind the GNU project. The FSF is for the most part financed by donations from sympathizers and aims to preserve, protect and promote the freedom to use, scrutinize, copy, modify and redistribute software and defend the rights of open source software users.

Finally, we should not forget that the collaborative development model associated with open source software is also very appealing to companies that do not consider the possibility of opening their resources to the community of open software users and developers or part of this community, but want to make private use of this collaborative development model and of the associated technologies and tools with a proven potential for success. It is a fact that many companies

use gateways for collaborative software development in their own internal networks to which their employees, business partners and/or customers have access. This way they benefit from the huge potential for resources communication and centralization that these gateways offer. These companies have their own needs that should be considered. Additionally, these companies may in time decide to release some of their proprietary developments. In this case, they often want to make public some parts and/or branches, while others are kept private.

CONCLUSION

Collaboration refers to the different processes wherein people, from small groups to larger collectives and societies, work together, possibly in ubiquitous environments like Internet. On the basis of the study of such processes and their distinctive properties, a number of useful and effective collaborative environments and methods have emerged and evolved to form collaborative development environments (CDE). We have defined a CDE as a virtual space wherein all project stakeholders, even if separated by time or distance, may negotiate, communicate, coordinate, brainstorm, discuss, share knowledge, and liaise to carry out some task, most often to create an executable deliverable and its supporting artefacts, holistically integrating multiple collaborative tools and resources. From this definition, the article has taken a step towards characterizing a CDE and has tackled the key purposes a CDE should serve and what services it should offer. The relationship there is between the rationale behind CDEs and research on CSCW and groupware has also been stressed. Next, a number of prominent classification frameworks have been listed with a view to enabling a team to make a grounded decision on what collaborative tools best meet its needs by contextualizing the range of collaborative tools available and comparing them from different points of view. Finally, we have discussed the role of CDEs in the development of open source communities and have shown how they influence each other.

REFERENCES

- Alioth Website. Retrieved March 7, 2007, from <http://alioth.debian.org>
- Baecker, R. (1993). *Readings in groupware and computer-supported cooperative work*. San Mateo: Morgan Kaufmann.
- BerliOS Website. *The open source mediator*. Retrieved February 11, 2007, from <http://www.berlios.de>
- Blender Website. *The free open source 3D content creation suite*. Retrieved February 11, 2007, from <http://www.blender3d.org>
- Booch, G., & Brown, A. W. (2003). Collaborative development environments. In M. Zelkowitz (Ed.), *Advances in computers*, 59, San Diego, CA: Academic Press.
- Conradi, R., & Westfechtel, B. (1998). Version models for software configuration management. *ACM Computing Surveys*, 30(2), 232–282.
- Engelbart, D. C. (1992). *Toward high-performance organizations: A strategic role for groupware*. Bootstrap Institute. Retrieved from <http://www.bootstrap.org/augdocs/augment-132811.htm>
- Ghosh, R. A. (Ed.). (2002). *Free/libre and open source software: Survey and study final report*. Berlin, Germany: International Institute of Infonomics, University of Maastricht, The Netherlands and Berlecon Research GmbH.
- Grudin, J. (1994). CSCW: History and focus. *IEEE Computer*, 27(5), 19–27.
- Helix Community Website. An open collaborative effort among multimedia enthusiasts. Retrieved from March 1, 2007, from <https://helixcommunity.org>
- Malone, T. & Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys (CSUR)*, 26(1), 87–119.
- NOC Postnuke Website. *Postnuke Network Operations Center*. Retrieved December 3, 2007, from <http://noc.postnuke.org>
- Nutt, G. (1996). The evolution towards flexible workflow systems. *Distributed Systems Engineering*, 3(4), 276–294.
- Sarma, A. (2005). *A survey of collaborative tools in software development* (ISR Technical Report UCI-ISR-05-3). Irvine, CA: University of California, Irvine.

Savannah Website. *A central point for development, distribution, and maintenance of GNU software*. Retrieved February 11, 2007, from <http://savannah.gnu.org>

Shah, S. K. (2005). Open beyond software. In C. Cooper & M. Stone (Ed.), *Open sources 2.0*. Sebastopol, CA: O'Reilly Media.

Software-Libre.org Website. *The free knowledge forge of the RedIRIS community*. Retrieved December 3, 2007, from <http://www.software-libre.org>

SourceForge Website. *The world's largest open source software development web site*. Retrieved February 11, 2007, from <http://sourceforge.org>

Van der Hoek, A., Redmiles, D., Dourish, P., Sarma, A., Silva Filho, R., & de Souza, C. (2004). Continuous coordination: A new paradigm for collaborative software engineering tools. In *Proceedings of Workshop on WoDISEE*, (pp. 29-36). Scotland.

Wynants, M., & Cornelis, J. (Ed.). (2005). *How open is the future? Economic, social & cultural scenarios inspired by free and open source software*. Brussels, Belgium: VUB Brussels University Press.

KEY TERMS

Collaborative Development Environment: A virtual space wherein all the stakeholders of a project, even if separated by time or distance, may negotiate, communicate, coordinate, brainstorm, discuss, share knowledge, and liaise to carry out some task, most often to create an executable deliverable and its supporting artifacts, holistically integrating multiple collaborative tools and resources.

Collaborative Tool: A software module conceived to assure that the people who design, produce, maintain, commercialize and use software are aware of and communicate about the activities of the others simply, efficiently and effectively, also encouraging creativity, driving innovation, and considering software development's social nature.

Collaboration: Refers to the different processes wherein people, from small groups to larger collectives and societies, work together, possibly in ubiquitous environments like Internet. A number of useful and effective collaborative environments and methods

have emerged from the study of such processes and their distinctive properties.

Computer-Supported Cooperative Work: A field of study addressing the way collaborative activities and their coordination can be supported by means of software and computer systems commonly referred to as groupware, as well as their psychological, social, and organizational effects.

Coordination: The management of dependencies between activities (generally representing independent subtasks as a result of the division of a cooperative task) and the support of (inter) dependencies among actors involved in carrying them out.

Groupware: Computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment, thanks to the enabling technologies of computer networking, software and services.

Open Source: This concept describes practices in production and development that promote access to the end product's sources and allow for the concurrent use of different agendas and approaches to production. Some consider it a philosophy, and others as a pragmatic methodology. Open source has come to represent much more than software whose source code may be freely modified and redistributed with few restrictions imposed by the terms of its distribution license. Information, documentation, and other "sources" generally related to innovation and knowledge building and sharing processes, tend to fall under the open source umbrella.

Open Source Community: A loosely organized, ad-hoc community of contributors from all over the world who share an interest in meeting a common need, ranging from minor projects to huge developments, which they carry out using a high-performance collaborative development environment, allowing the organizational scheme and processes to emerge over time. The concept represents one of the most successful examples of high-performance collaboration and community-building on the Internet.